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COMPLETE SPECIFICATION

"PROCESS FOR THE PRODUCTION OF AN INTRA-MUSCULARLY INJECTABLE IRON PREPARATION"

WE, AB ASTRA, a Swedish Corporation Body, of Kvarnbergagatan 16, Sodertalje, Sweden, do hereby declare the invention, for which we pray that a Patent may be granted to us , and the method by which it is to be performed, to be particularly described in and by the following statement:-

(followed by page 1a)

PROCESS FOR THE PRODUCTION OF AN INTRA-MUSCULAR INJECTABLE IRON PREPARATION

The present invention relates to an iron preparation suitable for intra-muscular injection in piglets and to a process for the manufacture of such an article, more particularly of an iron preparation mainly composed of an iron complex of high molecular weight.

The object of the invention is to increase meat production at pig breed by counteracting at an early stage the development of anaemia.

For this purpose it has already been suggested to use intra-muscular treatment with an iron dextrin complex which, however, has given rise to complications when applied to piglets owing to the fact that the complex is toxical when administered in such doses as are required for the treatment, as such a complex does not lend itself to the preparation of solutions having high iron concentrations. The consequence of this has been the necessity of employing comparatively large injection volumes.

Latterly it has been possible to establish that

the molecular weight of intramuscularly injectable iron complexes is of great importance for the toxicity and resorptional speed of the complex. Thus, it has been found that an iron complex with high molecular weight has shown lower toxicity and slower resorption than an iron complex with lower molecular weight.

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New Zealand Patent Specification No. 128589
~~The U.S. patent No. 3.252.863~~ describes an iron complex with low molecular weight. The complex is constituted by iron-sorbitol-citric acid stabilized with dextrin and the complex is intended for the treatment of anaemia in those occasions at which a dose of 1 - 5 milligrams Fe per kilogram of body weight can be used and a rapid resorption is desired. Iron complexes manufactured according to the method of manufacture described in said patent have

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average molecular weights not exceeding 5,000.

The toxicity of the complexes will due to this be in such that doses of 100 - 200 milligrams Fe per kilogram body weight which doses are required for the treatment of anaemia in piglets, cannot be administrated to the animals. The low molecular weight which is desirable is obtained by making use of the properties of the sorbitol in the primally forming of the complex.

The present invention has made it feasible to produce a stabilized high-molecular weight iron complex that meets the afore-mentioned requirements. By reason of its high-molecular weight and the slower resorption caused thereby

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the acute toxicity of the iron complex has become lower,

thereby making it possible to administer the required doses of the preparation to piglets without fear of complications.

The iron preparation according to the present invention may be produced by primally adding in portions a solution of water-soluble ferric salt, preferably ferric chloride or ferric sulphate, to a solution comprising 85 - 130 millilitres of lactic acid per 100 grams of added Fe and 200 - 300 grams of a water-soluble carbohydrate, preferably dextrin or alternatively saccharose or a low-molecular weight dextran fraction, per 100 grams of added Fe, adjusting the pH after each addition of said water-soluble ferric salt to a value between 4.0 - 8.0, preferably 6.5 - 7.6, precepitating the ferric colloid thus obtained with an organic solvent soluble in water, preferably alcohol (ethanol), and vacuum-drying it in order to obtain a dry preparation for subsequent dissolving in a solution comprising citric acid and a hexitol component, such as sorbitol, to form a polydisperse colloid with a molecular weight distribution of such order that ~~the principal part~~ most of the molecules exceed 40,000 in molecular weight.

As a suitable water-soluble carbohydrate dextrin is preferably used, but also saccharose or a low-molecular weight dextran fraction may be considered.

As suitable hexitol-components may be regarded sorbitol, mannitol, dulcitol and hydroxypropyl sorbitol.

The quantity of ferric salts added to the lactic acid and the carbohydrate is adjusted in order that the iron content in the dry preparation may amount to 25 - 35, preferably 28, percent by weight.

The dry preparation is added to a solution containing 5 - 20 grams of citric acid per litre of the injection solution and 50 - 150 grams of a hexitol-component per litre of the injection solution, in such quantities that the iron content of the finished injection solution may amount to not more than 110, preferably 100 milligrams, of Fe per millilitre.

While the ferric solution is being added to the solution containing the lactic acid and the water-soluble carbohydrate, the latter solution should preferably have a temperature of 15 - 125° C, preferably 50 - 75° C, the pH being adjusted by adding alkali after each portion of ferric solution in such quantities that a pH of 4.0 - 8.0, preferably 6.5 - 7.6, is obtained after each alkali addition.

The solution containing the citric acid and a hexitol-component should, while the dry preparation is being added, suitably have a temperature of 15 - 125° C, preferably 50 - 70° C. The dry preparation having been added to the solution, the pH of the solution is adjusted to 5.0 - 8.0, preferably 6.0 - 6.7, before the solution is sterilised.

The invention will be more fully explained here-

inafter, reference being made to the examples to follow, in which the parts and percentages mentioned hereinafter are by weight.

Example 1.

The alkali solution used in the example was composed of 450 grams of NaOH dissolved in 2,250 millilitres of distilled water.

A solution containing 672 grams of ferric chloride ($FeCl_3 \cdot 6\ H_2O$) dissolved in 900 millilitres of distilled water was added in 8 portions to a solution containing 324 grams of dextrin, 150 millilitres of lactic acid, and 180 millilitres of the afore-mentioned alkali solution. After each addition of the ferric chloride solution the reaction mixture was neutralised with 180 millilitres of the alkali solution while being stirred, the temperature of the mixture being kept at 60° C by heating in a water bath. The ferric chloride addition having been completed, the pH of the mixture was adjusted to 7.1 by means of the alkali solution and the mixture, having at first been heated at 60° C for 65 minutes, was cooled to 30° C and diluted with distilled water to a volume of 5,400 millilitres.

The ferric colloid thus obtained was precipitated while being stirred with 21,6 litres of diluted ethyl alcohol (5 parts of 99,5 percent alcohol + 1 part of distilled water) and the precipitate thus obtained was filtered off after 2 hours. The precipitate was thereupon dissolved in a lactate solution which had been heated to 60° C and which contained 150 millilitres of lactic acid

and 180 millilitres of the alkali solution in 3,600 millilitres of distilled water. After 25 minutes, when the substance was fully dissolved and the pH of the solution amounted to 4.6, the pH was adjusted by means of the alkali solution to 7.2. The solution was heated while being stirred for 50 minutes at 60° C, and was thereupon cooled off to 30° C while still being stirred.

This solution having been filtered and diluted to 5,400 millilitres, the ferric colloid was precipitated, while the solution was being stirred, by adding thereto 21,6 litres of ethyl alcohol (5 parts of 99,5 % alcohol + + 1 part of distilled water). The precipitate was filtered off and washed with alcohol for subsequent drying in vacuum at 40 - 50° C.

355 grams of the dry preparation thus obtained were added by portions while stirring to a solution having a temperature of 60° C and containing 100 millilitres of sorbitol (c:a 70 %) and 17,0 grams of citric acid (one hydrate water) dissolved in 500 millilitres of distilled water, the temperature of the mixture being thereupon maintained at 60° C for 65 minutes. The pH value was then adjusted with the alkali solution until a pH of 7.7 was finally obtained, the solution being thereupon diluted to 1,000 millilitres with distilled water, and filtered. The solution was then dispensed in injection ampoules which were sterilised at 120° C for 20 minutes.

The sterilised iron solution had a total iron

content of 99,7 milligrams of Fe per millilitre, a pH value of 6,3, a viscosity of 17,9 centipoises at 20° C, a freezing point depression of 3,02° C and a specific weight of 1,230 grams per cc.

By re-dissolving the ferric colloid precipitated at the first addition of ethanol in a lactate solution and precipitating an improved purification and dispersion of the colloid is obtained.

In order to determine the molecular size of the iron complex produced according to the invention in relation to dextran with a molecule weight of 40,000, gel filtering experiments were carried out using Sephadex G 200 (Pharmacia, Uppsala, Sweden) suspended in a 0,9 % NaCl-solution. It was found that the greater part of the preparation produced in the way set forth in the example occurs in a fraction that passed the gel faster than dextran 40, i.e. the greater part of the complex produced according to the invention has a molecular weight in excess of 40,000.

Example 2.

51,5 grams of a dry preparation produced according to example 1 were added by portions while stirring to a solution having a temperature of 65° C and containing 7,5 grams of mannitol and 3,0 grams of citric acid (one hydrate water) dissolved in 75 millilitres of distilled water, the temperature of the mixture being thereupon maintained at 68 - 70° C for 50 minutes. The pH value was then

adjusted with the alkali solution until a pH of 7.5 was finally obtained, the solution being thereupon diluted to 150 millilitres with distilled water, and filtered. The solution was then dispensed in injection ampoules which were sterilised at 120° C for 20 minutes.

The sterilised iron solution had a total iron content of 103 milligrams of Fe per millilitre, a pH value of 6,0, a viscosity of 16,2 centipoises at 20° C and a specific weight of 1,270 grams per cc.

Example 3.

The alkali solution used in the example was composed of 144 grams of NaOH dissolved in 720 millilitres of distilled water.

A solution containing 224 grams of ferric chloride ($FeCl_3 \cdot 6\ H_2O$) dissolved in 300 millilitres of distilled water was added in 8 portions to a solution containing 115 grams of saccharos, 50 millilitres of lactic acid, and 60 millilitres of the afore-mentioned alkali solution. After each addition of the ferric chloride solution the reaction mixture was neutralised with 60 millilitres of the alkali solution while being stirred, the temperature of the mixture being kept at 60° C by heating in a water bath. The ferric chloride addition having been completed, the pH of the mixture was adjusted to 7.6 by means of the alkali solution and the mixture, having at first been heated at 60° C for 90 minutes, was cooled to room temperature and diluted with distilled water to a

volume of 1,800 millilitres.

The ferric colloid thus obtained was precipitated while being stirred with 7,200 millilitres of diluted alcohol (6,000 millilitres of 99,5 percent ethyl alcohol + + 1,200 millilitres of distilled water) and the precipitate thus obtained was filtered off after 2 days and washed with alcohol of the same concentration as the mother liquor and then with absolute alcohol.

The precipitate was thereupon dissolved in a lactate solution which had been heated to 60° C and which contained 50 millilitres of lactic acid and 60 millilitres of the alkali solution in 800 millilitres of distilled water. After 20 minutes when the substance was fully dissolved and the pH of the solution amounted to 5.1 the pH was adjusted by means of 37 millilitres of the alkali solution to 7.1. The solution was heated while being stirred for 50 minutes at 60° C, and was thereupon cooled off to room temperature while still being stirred.

This solution having been filtered, the ferric colloid was precipitated once again while the solution was being stirred, by adding thereto 7,200 millilitres of diluted ethyl alcohol. The precipitate was filtered off and washed with alcohol of the same concentration as the mother liquor and then with absolute alcohol for subsequent drying in vacuum at 40 - 50° C.

An injectiable solution was prepared from the dry preparation thus obtained as described in example 1.

31,9 grams of dry ferric colloid were added by portions to a solution containing 22,5 grams of sorbitol and 2,55 grams of citric acid (one hydrate water) dissolved in 75 millilitres of distilled water.

The sterilised iron solution had a total iron concentration of 102,0 milligrams of Fe per millilitre, a pH value of 5,5, a viscosity of 3,2 centipoises at 20° C, a freezing point depression of 2,38° C and a specific weight of 1,196 grams per cc.

In a like manner complexes can be prepared following the procedures described in Examples 1 - 3, substituting, for example, ferric sulfate, ferric nitrate, and double ferric salts such as ferric ammonium sulfate for the ferric chloride specifically referred to above; substituting low molecular weight dextran particles or glucose for the dextrin or saccharose referred to above; substituting iditol, dulcitol, or hydroxypropyl sorbitol for the mannitol or sorbitol; and/or substituting ammonium hydroxide for sodium hydroxide referred to in Examples 1 - 3.

Example 4.

The ammonium hydroxide solution used in the example was composed of 208 millilitres of conc. NH_4OH, which was diluted with distilled water to a volume of 500 millilitres.

A solution containing 105,24 grams of ferric sulfate $Fe_2(SO_4)_3 \cdot 6\ H_2O$) dissolved in 150 millilitres

of distilled water was added in 8 portions to a solution containing 54 grams of dextrin, 25 millilitres of lactic acid, and 30 millilitres of the afore-mentioned ammonium hydroxide solution. After each addition of the ferric sulfate solution the reaction mixture was neutralised with 30 millilitres of the ammonium hydroxide solution while being stirred, the temperature of the mixture being kept at 60° C by heating in a water bath. The ferric sulfate addition having been complete, the pH of the mixture was adjusted to 7.1 by means of 15 millilitres of a 2/N 2-n HCl solution and the mixture, having at first been heated at 60° C for 65 minutes, was cooled to room temperature and diluted with distilled water to a volume of 930 millilitres.

The ferric colloid thus obtained was precipitated while being stirred with 3,600 millilitres of diluted ethyl alcohol (3,600 millilitres of 99.5 percent alcohol + 600 millilitres of distilled water) and the precipitate thus obtained was filtered off. The precipitate was thereupon dissolved in a lactate solution which had been heated to 60° C and which contained 25 millilitres of lactic acid and 30 millilitres of the ammonium hydroxide solution in 600 millilitres of distilled water. After 20 minutes, when the substance was fully dissolved and the pH of the solution amounted to 4.7, the pH was adjusted by means of 14 millilitres of the ammonium hydroxide solution to 7.0. The solution was heated while

being stirred for 50 minutes at 60° C, and was thereupon cooled off to room temperature while still being stirred.

This solution having been filtered and diluted to 900 millilitres, the ferric colloid was precipitated, while the solution was being stirred, by adding thereto 3,600 millilitres of ethyl alcohol (3,000 millilitres of 99,5 % ethyl alcohol + 600 millilitres of distilled water). The precipitate was filtered off and washed with alcohol for subsequent drying in vacuum at 40 - 50° C. The yield was 86,72 grams with a total iron amount of 23,6 % Fe. 63,6 grams of the dry preparation thus obtained were added by portions while stirring to a solution having a temperature of 60° C and containing 13,5 grams of sorbitol and 2,55 grams of citric acid dissolved in 95 millilitres of distilled water, the temperature of the mixture being thereupon maintained at 60° C for 65 minutes. The pH value was then adjusted with a 1/N sodium hydroxide solution until a pH of 6.55 was finally obtained, the solution being thereupon filtered, and was then dispensed in injection ampoules which were sterilised at 120° C for 20 minutes.

The sterilised iron solution had a total iron content of 99,5 milligrams of Fe per millilitre, a pH value of 5.45, a viscosity of 32,4 centipoises at 20° C, a freezing point depression of 3,43° C and a specific weight of 1,230 grams per cc.

For the purpose of demonstrating the technical

effect of the iron preparation made known by the invention a series of tests were carried out as set out in the following; the iron preparation used in the tests having been produced in the way described in the preceding Example 1.

For the tests, 6 farrows of piglets were used all of which were cross breed products of Swedish Mixed Breed and Yorkshire. The animals were during the test period kept in stable compartments built in concrete, and the milieu was in other respects deficient in iron. The feeding of the mother sows consisted of 90 % of corn (equal parts of barley and oats) and 10 % of a commercially available sow food concentrate. The size of the daily food ration was 3 kilos during the gestation period and until 2 weeks after partus, after which time the said feed mixture was increased to 4 kilos.

4 - 5 weeks after their treatment with the iron preparation produced according to the invention the piglets received an iron-containing additional food consisting of 80 % of corn (equal parts of barley and oats) and 20 % of commercially available young pig food concentrate.

The treatment of the piglets with the preparation according to the invention was carried out by intramuscular injection in the neck region. Before, and at different time after the injection determination were made of Hb, iron content of serum and iron-bonding capacity, and for this purpose a total quantity of 10 milli-

litres of blood from vena jugularis was used. For the analysis of the remaining quantity of iron in the muscle all the muscles at and around the place of injection, at the least 100 grams of tissues, were used for incineration procedure at different times following the intramuscular administration.

Farrow 1 consisted of 5 animals, which were treated 4 days after birth with a dose corresponding to 100 milligrams of iron per 1,5 kilograms of body weight. The average weight was 2,0 kilograms at the time of treatment. 2 animals were killed 6 hours and 3 animals were killed 6 days after the injection for the determination of the resorption.

Farrow 2 consisted of 9 animals, which were treated 8 days after birth with the same dose as the first farrow. The average weight was 2,7 kilograms at the time of treatment. For the determination of the resorption 3 animals were killed after 6 hours, 3 animals after 6 days, and 3 animals after 56 days after the injection, the average weight of the 3 last mentioned animals being 21,0 kilograms.

Farrow 3 consisted of 12 animals which were treated 2,5 days after birth with a dose corresponding to 270 milligrams of iron per animal. The average weight at the time of treatment was 1,8 kilograms. 4 weeks later it was 7,4 kilograms and 5 weeks after the treatment it was 8,8 kilograms. For the determination of the resorp-

tion 4 animals were killed 60 days and 5 animals 112 days after the administration.

Farrow 4 consisted of 10 animals of which 3 animals were treated 3 days after birth with a dose corresponding to 270 milligrams iron per animal. The treated animals were killed 28 days after the administration for the determination of the resorption.

Farrow 5 consisted of 7 animals and comprised a control group. The average weight was 1,9 kilograms 3 days after birth and 5,6 kilograms 24 days after birth.

Farrow 6 consisted of 12 animals with an average weight of 1,2 kilograms 8 hours after birth. At that time blood tests were taken from 5 of the animals. (Control group).

The values of resorption obtained in the tests are shown in the table.

Table

Farrow/ number of animals killed	Age at the time of treatment days	Time of death, days after treatment	Dose, milligrams of Fe	Milligrams of Fe in the muscles	Resorption %	Resorption, average value %
1/2	4	1/4	140	90,1	35,6	
			135	82,1	39,2	
2/3	8	1/4	183	115,5	36,9	
			147	95,5	35,0	
			187	103,5	44,7	38,3
1/3	4	6	135	58,5	56,7	
			100	51,5	48,5	
			140	63,0	55,0	
2/3	8	6	180	67,5	62,5	
			187	86,5	53,7	
			200	86,5	56,8	55,5
4/3	3	28	270	38,0	85,9	
			270	37,0	86,3	
			270	42,0	84,4	85,5
2/3	8	56	193	7,1	96,3	
			166	5,9	96,5	
			180	3,2	98,2	97,0
3/4	2,5	60	270	1,2	99,6	
			270	3,6	98,7	
			270	1,9	99,3	
			270	1,3	99,5	99,3
3/5	2,5	112	270	1,5	99,4	
			270	0,9	99,7	
			270	1,0	99,6	
			270	1,0	99,6	
			270	0,5	99,8	99,6

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As will be seen from the table there takes place an immediate resorption of the administered iron, 38,3 % thereof having been removed already after 6 hours from the place of injection. After this rapid phase of resorption the rate of the latter slows down, 55,5 % of iron having been resorbed after 6 days and 97,0 % after 56 days. 16 weeks after the treatment the remaining iron at the place of injection comprised less than 0,5 % of the administered quantity of iron. As will also be seen from the table the size of the dose does not seem to affect the degree of resorption 8 weeks after the treatment.

The values of haemoglobin obtained from the tests are given in Figs. 1 and 2, of which Fig. 1 shows the average values pertaining to the control groups (farrows 5 and 6) from the first day of life until the 24th day of life, and Fig. 2 shows the average values from, on the one hand, animals treated with 180 milligrams of Fe (3 animals from farrow 2), and on the other hand, the average values from animals treated with 270 milligrams of Fe (7 animals from farrow 3). In order to facilitate observation of the effect of the injected iron preparation on the haemoglobin values during a prolonged period of time iron-containing additional food, which is normally given at the age of 3 weeks, was administered not earlier than at the age of 5 weeks (indicated with arrows in Fig. 2).

It will be seen from Fig. 1 that there occurs

a continuous lowering of the haemoglobin content in the blood of the untreated animals. 24 days after partus the animals exhibit a very grave anaemia condition with only 4,7 grams of haemoglobin (Hb) per 100 millilitres of blood. The cause of this remarkable disimprovement of the blood value has, inter alia, to do with the fact that a newly born pig will under normal growth conditions double its body weight in about 8 days, resulting in a powerful increase of the blood volume. Generally, Hb-values below 9 grams of Hb/100 millilitres of blood are regarded as anaemia, a border line at which it is possible to ascertain clinically that a condition of anaemia prevails. Iron deficiency and disturbances of the iron balance occur, however, also at considerably higher Hb-values.

As will be seen from Fig. 2 an increase of the haemoglobin content of the blood takes place after the injection of the smaller dose (180 milligrams of Fe per animal) during the first week after the treatment, but already after another week the big growth and the haemoglobin synthesis make themselves felt, resulting in a small lowering of the haemoglobin value. This lowering becomes thereupon accentuated with the result that the haemoglobin content in the blood of the animals will have reached a value of about 7,5 grams per 100 millilitres of blood about 4 weeks after treatment.

Following a treatment with the higher dose (270

milligrams of Fe per animal) a continuous increase of the haemoglobin content of the animals takes place until 3 weeks after the treatment despite the great growth and haemoglobin formation. Three weeks after the injection the Hb value is about 12 grams of Hb per 100 millilitres of blood. The added quantity cannot entirely compensate for the great iron demand existing in the rapidly growing animals. A lowering of the Hb-values will therefore come to sight 4 weeks after the treatment, and after 5 weeks the values will have fallen to about 11 grams of Hb per 100 millilitres of blood. After iron-containing extra food is put on, an increase of the haemoglobin content in the blood will occur, resulting in values around 13 - 14 milligrams of Hb per 100 millilitres of blood being obtained when the animals have reached the age of about 9 weeks.

The matter contained in each of the following claims is to be read as part of the general description of the present invention.

~~We claim:~~

XXXXXXXX
WHAT WE CLAIM IS :-

~~XXXXXXXXXXXXXXXXXXXXXXXXX~~

1. A process for the production of an iron preparation suitable for intra-muscular injection in piglets to secure increased ~~optimal~~ meat production, said iron preparation mainly containing a high-molecular weight iron complex, the steps of the process comprising ~~the production of a high-molecular iron complex by~~ adding primally in portions a solution of a water-soluble ferric salt, preferably ferric chloride or ferric sulphate to a solution containing 85 - 130 millilitres of lactic acid per 100 grams of added Fe and 200 - 300 grams per 100 grams of added Fe of a water-soluble carbohydrate preferably dextrin or alternatively saccharose or a low-molecular weight dextran fraction, the pH after each addition of said water-soluble ferric salt being adjusted to 4.0 - 8.0, preferably 6.5 - 7.6, whereupon the ferric colloid thus obtained is precipitated with an organic solvent compatible with water, preferably alcohol and desiccated in vacuo to form a dry preparation, said dry preparation being dissolved in a solution containing citric acid and a hexitol-component, such as sorbitol, for the formation of a poly-disperse colloid with such molecular weight distribution that most ~~the principal part~~ of

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the molecules have a molecular weight exceeding 40,000.

2. A process according to claim 1, in which the ferric colloid precipitated with alcohol is dissolved in a lactate solution and thereupon precipitated in alcohol before being desiccated in vacuo.

3. A process according to claim 1, in which the quantity of ferric salt added to the solution is adjustable to produce an iron content in the dry preparation amounting to between 25 - 35 percent by weight, preferably 28 percent by weight.

4. A process according to claim 1, in which the dry preparation is dissolved in a solution containing 5 - 20 grams of citric acid per litre of injection solution and 50 - 150 grams of a hexitol-component per litre of injection solution, said dry preparation being added in such quantity that an injection solution containing not more than 110, preferably 100, milligrams of Fe per millilitre is obtained.

5. A process according to claim 1, in which the pH of the solution after the addition of the dry preparation is adjusted to 5.0 - 8.0, preferably 6.0 - 7,7, said solution being thereupon sterilised by heating.

6. Stabilised high-molecular weight anti-anaemia iron preparation for intra-muscular administration in piglets, said iron preparation comprising a polydisperse colloid mainly containing a high-molecular weight complex said complex being pre-

pared by adding primally in portions a solution of a water-soluble ferric salt, preferably ferric chloride or ferric sulphate, to a solution containing 85 - 130 millilitres of lactic acid per 100 grams of added Fe and 200 - 300 grams per 100 grams of added Fe of a water-soluble carbohydrate preferably dextrin or alternatively saccharose or a low-molecular weight dextran fraction, the pH after each addition of said water-soluble ferric salt being adjusted to 4.0 - 8.0, preferably 6.5 - 7.6, whereupon the ferric colloid thus obtained is precipitated with an organic solvent compatible with water, preferably alcohol, and desiccated in vacuo to form a dry preparation, said dry preparation being dissolved in a solution containing citric acid and a hexitol-component such as sorbitol, ~~the~~ most ~~principal part~~ of the molecules of said polydisperse colloid having a molecular weight exceeding 40.000.

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7. A method for securing ~~optimal~~ increased meat production by preventing anaemia in piglets comprising intramuscular injection to piglets of a stabilised high-molecular iron preparation, said iron preparation containing a polydisperse colloid mainly consisting of a high-molecular weight complex, said complex being prepared by adding primally in portions a solution of a water-soluble ferric salt, preferably ferric chloride or ferric sulphate to a solution containing 85 - 130 millilitres of lactic acid per 100 grams of added Fe and 200 - 300 grams per 100 grams of added Fe of a water-soluble carbohydrate prefer-

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ably dextrin or alternatively saccharose or a low-molecular weight dextran fraction, the pH after each addition of said water-soluble ferric salt being adjusted to 4.0 - 8.0, preferably 6.5 - 7.6, whereupon the ferric colloid thus obtained is precipitated with an organic solvent compatible with water, preferably alcohol, and desiccated in vacuo to form a dry preparation, said dry preparation being dissolved in a solution containing citric acid and a hexitol-component, such as sorbitol, most of the molecules of said polydisperse colloid having a molecular weight exceeding 40,000.

8. A process according to claim 1, substantially as described herein.

9. An iron preparation according to claim 6, substantially as described herein.

10. A method according to claim 7, substantially as described herein.

~~DATED this 13th day of October A.D.1970.~~

AB ASTRA,
By its Patent Attorneys
HENRY HUGHES LIMITED
PER: